Amendments to the Specification:

Please replace paragraph [01] with the following amended paragraph:

[01] This application claims the benefit of U.S. provisional application number 60/228,222, filed August 25, 2000, which is hereby incorporated herein by reference.

Please add the following new paragraph after the section heading entitled "BACKGROUND OF THE INVENTION" and before paragraph [02]:

[01.1] 1. Field of the Invention

Please replace paragraph [02] with the following amended paragraph:

[02] The present invention relates generally to optical devices, and more particularly to optical wavelength division ~~multiplexer~~ multiplexers and demultiplexers.

Please add the following new paragraph after paragraph [02] and before paragraph [03]:

[02.1] 2. Discussion of the Background

Please replace paragraph [04] with the following amended paragraph:

[04] Optical wavelength division multiplexers and demultiplexers are important elements in optical technology. An optical ~~Optical~~ wavelength division multiplexer receives ~~multiplexers receive~~ two or more individual wavelengths (also referred to as colors or frequencies) and ~~combine~~ combines them into one signal on a single waveguide. An optical ~~Optical~~ wavelength division demultiplexer receives ~~demultiplexers receive~~ an optical signal with two or more wavelengths from a single waveguide and ~~separate~~ separates the optical signal into its component frequencies. Optical multiplexers and demultiplexers are crucial to take advantage of the enormous bandwith of optical waveguides.

Please replace paragraph [07] with the following amended paragraph:

[07] The present invention is directed toward ~~course~~ coarse wavelength data transmission. In particular, it provides a coarse wavelength division multiplexer/demultiplexer for combining and splitting different frequencies that are not as tightly separated as commonly known dense wavelength systems. Because the tolerances of the system are not as stringent, the costs of manufacture and use as well as reliability are improved over the existing art.

Please replace paragraph [11] with the following amended paragraph:

[11] In yet another embodiment of the present invention, long or short-pass filters are optically coupled together along the optical axis of an I/O waveguide with a plurality of wavelengths. The specified wavelength of each filter changes monotonically such that each filter splits off a different wavelength and reflects that wavelength to a different waveguide. The other wavelengths pass to the next filter until all but one have been split off. The remaining wavelength passes to its own waveguide. Thus, light is reflected between the various individual waveguides and ~~the in~~ the I/O waveguide having the plurality of wavelengths. In another embodiment, the long-pass and short-pass filters are curved to focus the light as it is reflected.

Please add the following new paragraph after the section heading entitled "BRIEF DESCRIPTION OF THE DRAWINGS" and before paragraph [13]:

[12.1] A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered with the accompanying drawings, wherein:

Please add the following new paragraph after the section heading entitled "DESCRIPTION OF THE SPECIFIC EMBODIEMENTS" and before paragraph [17]:

[16.1] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views.

Please replace paragraph [17] with the following amended paragraph:

[17] Figure 1 is a block diagram of an optical system 100 into which a device according to the present invention may be incorporated. Optical system 100 inlcudes a plurality of optical devices 100a-d coupled to an optical multiplexer/demultiplexer 120 through optical waveguide 125a-d, respectively. Each optical device 110 is coupled to the optical multiplexer/demultiplexer through a separate waveguide 125 and carries one or more different wavelengths (also referred to as optical frequencies or colors~~.~~). In the specific embodiment, each optical device 110 outputs a single wavelength onto waveguide 125 or receives a single wavelength from waveguide 125. Waveguide 125 may be a single waveguide that is used bidirectionally or, more likely, a pair of waveguides each transmitting in a different direction. The term "carry" is used to refer generically to transmittal of a wavelength without reference to direction ~~or~~ of travel. Thus, a waveguide transmitting or receiving a particular wavelength is said to carry that wavelength.

Please replace paragraph [18] with the following amended paragraph:

[18] Though four optical devices 110 are shown in Figure 1, any number of optical devices may be used, depending on the capabilities of the technology and the application for which it is intended. Optical devices 110 may be lasers, optical switches, electrical converters, couplers, other optical multiplexer/demultiplexers, and the like. For example, optical devices 110 may ~~be~~ include a distributed feedback (DFB) laser. DFB lasers are commercially available that are internally modulated at 2.5 gigabits/second, 3.7 gigabits/second, or 10 gigabits/second,

for example. Moreover, optical devices 110 may all be the same type of device, or, some or all, may be different types of devices.

Please replace paragraph [20] with the following amended paragraph:

[20] Optical multiplexer/demultiplexer 140 is also coupled to a plurality of optical devices 160a-d through waveguides 165a-d, respectively. Optical devices 160 may be any optical ~~devices~~ device such as those described above with regard to optical devices 110. They may all be different types of devices, or, some or all, may be ~~the~~ exactly the same or similar types of devices. Also, any number of optical devices 160 may be included in system 100.

Please replace paragraph [21] with the following amended paragraph:

[21] Optical multiplexer/demultiplexer 120 either receives individual signals with different wavelengths from each of the waveguides 125 and combines them into a single optical signal for output on waveguide 150 ~~130~~ (the multiplexing function) or receives an optical signal with a plurality of different wavelengths from waveguide 150 ~~130~~ and splits the wavelength onto the plurality of different waveguides 125 (the demultiplexing function). While Figure 1 depicts a generic system in which optical multiplexer/demultiplexer 120 may be used, one of skill in the art will readily envision a variety of systems that would be benefited by its use. For example, local area networks, SONET networks, local intercomputer communication, local voice and video communication, distribution from a network and uploading to a network, and switching networks are all useful systems that would benefit from the present invention. For example, optical multiplexer/demultiplexer 120 may be used in an add/drop circuit for a SONET network. Those skilled in the art will recognize several additional applications for which the present

invention is beneficial. Moreover, the future undoubtedly holds the promise of many other applications that will also benefit from the present inventions.

Please replace paragraph [22] with the following amended paragraph:

[22] Figure 2 shows a first embodiment of a ~~course~~ coarse wave division multiplexer/demultiplexer 200 according to the present invention. Optical multiplexer/demultiplexer 200 is preferably formed in a housing 205. Housing 205 is preferably designed to maintain the proper orientation of the various parts of multiplexer/demultiplexer 200. In the specific embodiment, housing 205 is a machined optical bench formed from aluminum, though other materials may also be used.

Please replace paragraph [24] with the following amended paragraph:

[24] Waveguide 130 carries a signal with a plurality of different wavelengths. For simplicity, the plurality of wavelengths is referred to as "color 1," "color 2," "color 3," and "color 4," ~~"color 1", "color 2", "color 3", and "color 4",~~ though any number of wavelengths may be used. In the specific embodiment shown, the four wavelengths are separated by approximately 25.6 nanometers ~~about 25.6 nanometer~~ in wavelength, color 1 having the shortest wavelength, color 2 having a longer wavelength than color 1, color 3 having a longer wavelength than color 2, and color 4 having the longest wavelength of the four wavelengths. Of course, the separation between the wavelengths may be greater or ~~less~~ lesser than the specific embodiment. Waveguides 125 each carry a different one of the four wavelengths while waveguide 130 carries all four wavelengths. Thus, in the specific embodiment, waveguide 125a carries color 1, waveguide 125b carries color 2, waveguide 125c carries color 3, and waveguide 125d carries ~~caries~~ color 4. Waveguide 130 carries colors 1-4.

Please replace paragraph [26] with the following amended paragraph:

[26] In order to maintain their positioning within multiplexer/demultiplexer 200, lenses 210 and 230 are affixed to housing 205 by conventional methods. In the specific embodiment, lenses 210 and 230 are mounted in housing 205 and waveguides 125 and 130 extend outwardly from housing 205. Waveguides 125 and 130 connect to lenses 210 and 230 outside the housing. Other arrangements may easily be envisioned and are included within the scope of the present invention.

Please replace paragraph [28] with the following amended paragraph:

[28] Filters 240, 250, and 260 may be either long-pass filters or short-pass filters. Long-pass filters are characterized as having a specified wavelength such that wavelengths that are greater than the specified wavelength are passed, while wavelengths that are less than the specified wavelength are reflected. Similarly, short-pass filters pass those wavelengths that are less than the specified wavelength and reflect those wavelengths that are greater than the specified wavelength. Thus, generically speaking ~~they~~, long-pass filters and short-pass filters are characterized by passing the wavelengths on one side of the specified wavelength and reflecting those wavelengths on the other side of the specified wavelength. Therefore, though no generic term referring to both long-pass filters and short-pass filters is known, the term "single-side-pass filter" is used to refer generically to a filter that passes the wavelengths on one side of a specified wavelength and reflects those wavelengths on the other side of the specified wavelength. For simplicity, the following description is directed toward long-pass filters, but the principles of the present invention can be easily extended to short-pass filters.

Please replace paragraph [31] with the following amended paragraph:

[31] Filter 240 is aligned with lens 230 and lens 210a such that the collimated beam of light from lens 230 strikes it in one of its surfaces. Filter 240 reflects the light emitted from waveguide 130 that is shorter than the specified wavelength (color 1) and allows the longer wavelengths to pass (colors 2, 3, and 4). It is oriented such that the reflected light is reflected at approximately a 90-degree angle to lens 210a. Preferably, it is exactly 90 degrees. Filter 250 is aligned on the opposite side of filter 240 such that the collimated beam of light in the wavelengths that were passed through filter 240 strike one of its surfaces. Filter 250 reflects the light with a shorter wavelength ~~then~~ than the specified wavelength (color 2) and passes the longer wavelengths (colors 3 and 4). Filter 250 is oriented such that the reflected light is reflected at a 90-degree angle to lens 210b. Similarly, filter 260 is aligned on the opposite side of filter 250 such that the collimated beam of light in the wavelengths that were passed through filter 250 strike one of its surfaces. Filter 260 reflects the light with a shorter wavelength than its specified wavelength (color 3) and passes the longer wavelengths (color 4). Filter 260 ~~250~~ is oriented such that the reflected light is reflected at a 90-degree angle to lens 210c. The remaining ~~nonreflected~~ non-reflected light (color 4) passes on to lens 210d. It will be recognized that such a device may split multiple wavelengths to any of the different waveguides 125 if they fall within the range of frequencies between the specified wavelengths of the filters. Accordingly, it may be seen that cascading multiple multiplexer/demultiplexers 200 together allows more wavelengths to be split than with a single device.

Please replace paragraph [34] with the following amended paragraph:

[34] Figure 3 shows a second embodiment of the present invention. A coarse ~~course~~ wave division ~~demultiplexer~~ multiplexer/demultiplexer 300 is shown using filters 340, 350, and

360 to transmit optical signals into waveguides 125a-c. As described above with respect to filters 240-260, filters 340-360 are long-pass or short-pass filters with specified wavelengths designed to differentiate between the various colors being carried on waveguide 130 ~~230~~. But in contrast to those filters, filters 340-360 are built on a concave curved substrate. The curvature on the receiving edge of filters 340-360 reflects some of the selected colors and focuses the light signal with those selected colors. Preferably, optical waveguides 125a-c ~~325a-c~~ are positioned such that colors reflected from the concave surfaces of ~~filter~~ filters 340-360 are focused into waveguide 125a, without the use of any other lens. Of course, such an arrangement reduces the number of lenses necessary to accomplish the multiplexing and demultiplexing function.

Please replace paragraph [35] with the following amended paragraph:

[35] Figure 4 shows a third embodiment of a coarse ~~course~~ wave division multiplexer/demultiplexer 420. Optical multiplexer/demultiplexer 420 receives or transmits a plurality of colors on waveguide 430, and receives or transmits a subset of the plurality of colors on each of the waveguides 425a, 425b, 425c, and 425d. Typically, a single color is transmitted on waveguides 425, but the invention is not so limited. Moreover, though only four colors are shown in Figure 4, the invention is not limited to exactly four colors, but may be useful for more than four or less than four colors being combined onto a single waveguide 430. In the specific embodiment, waveguide 420 carries four wavelengths (colors 1-4) while waveguide 425a carries color 3, waveguide 425b carries color 1, waveguide 425c carries color 4, and waveguide 425d carries color 2. The colors are named for convenience in this description and have no bearing on any relationship between the wavelengths of those colors.

Please replace paragraph [37] with the following amended paragraph:

[37] A collimator assembly 440 is optically coupled to waveguide 430. Collimator assembly 440 is a dual capillary GRIN lens comprising a waveguide assembly 442 with two optical waveguides and a GRIN lens 444. One of the optical waveguides of waveguide assembly 442 is coupled to waveguide 430. Typical optical waveguides used include SMF28 single mode fiber by Corning, LEEF fiber or Metricore fiber. A metal tube secures waveguide assembly 442 rigidly at a fixed distance from GRIN lens 444. The numerical aperture of the waveguide and the wavelength of the optical signals determine the distance between the end of the waveguides and the GRIN lens. As described above, a GRIN lens is a transparent, cylindrical device formed from glass or other transparent material. It is characterized by having an index of refraction that varies predictably throughout the device. GRIN lenses are used especially for focusing a collimated beam of light into a narrow beam of light (if used in one direction) or dispersing a light source to create a collimated beam of light (if used in the other direction).

Please replace paragraph [38] with the following amended paragraph:

[38] A filter 448 is optically coupled to the other side of ~~DC GRIN lens~~ dual capillary GRIN lens of the collimator assembly 440. Filter 448 is oriented such that light carried on waveguide 430 passes through one of the waveguides in collimator assembly 440 and strikes a surface of filter 448. Filter 448 is a long-pass filter or a short-pass filter and may be fabricated in the manner described above with respect to filter 240. Filter 448 is calibrated such that the specified wavelength is at a point whereby some of the wavelengths carried on waveguide 430 ~~420~~ are on one side of the specified wavelength and the others are on the other side of the specified wavelength. Thus, in the specific embodiment, filter 448 is calibrated to reflect color 1

and color 3, and to pass color 2 and color 4. Moreover, filter 448 is oriented such that the reflected light is directed to the other waveguide of waveguide assembly 442.

Please replace paragraph [40] with the following amended paragraph:

[40] A jumper waveguide 455 is attached to the waveguide of collimator assembly 450. Waveguide 455 optically couples collimator assembly 450 to another collimator assembly 460. In the specific embodiment, jumper waveguide 455 ~~475~~ carries color 2 and color 4. Collimator assembly 460 ~~450~~ is a dual capillary GRIN lens similar to collimator assembly 440. A first waveguide of collimator assembly 460 is coupled to jumper waveguide 455 and the other is coupled to waveguide 425c.

Please replace paragraph [43] with the following amended paragraph:

[43] Referring back to the second waveguide of collimator assembly 440, it is optically coupled to a jumper waveguide 475. Waveguide 475 optically couples collimator assembly 440 to another collimator assembly 480. In the specific embodiment, jumper wveguide 475 carries color 1 and color 3. Collimator assembly 480 is also a dual capillary GRIN lens similar to collimator assembly 440. A first waveguide of collimator assembly 480 is coupled to jumper waveguide 475 and the other is coupled to waveguide 425a.

Please replace paragraph [44] with the following amended paragraph:

[44] A filter 488 is located on the opposite side of collimator assembly 480. Filter 488 is a long or short-pass filter that is oriented such that the light from collimator assembly 480 ~~460~~ strikes one of its surfaces. Filter 488 has a specified frequency such that some of the frequencies carried on jumper waveguide 475 are reflected and others are passed. Filter 488 is also oriented such that the wavelengths that are reflected because they are on one side of the specified

frequency are reflected back to waveguide 425a. In the specific embodiment, color 3 ~~color 4~~ is reflected to waveguide 425a and color 1 is passed.

Please replace paragraph [45] with the following amended paragraph:

[45] Another collimator assembly 490 is optically coupled to filter 488. It is located on the opposite side of filter 488 from collimator assembly 480 such that light that passed through filter 488 enters collimator assembly 490. Collimator assembly 490 may be a single capillary GRIN lens. It is also oriented such that the GRIN lens portion is optically coupled to filter 488 and light passing through filter 488 is focused onto the waveguide. The waveguide is optically coupled to waveguide 425b. Thus, in the specific embodiment, color 1 is carried on waveguide 425b.